Faculty Working Papers

Capital Coefficients, Propensities to Save, Calculated and Actual Growth Rates in Eight Countries 1954-1969

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CAPITAL COEFFICIENTS, PROPENSITIES TO SAVE, CALCULATED AND ACTUAL GROWTH RATES IN EIGHT COUNTRIES 1954-1969

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1. Introduction

On the eve of its changeover to a new system of national accounts, the OECD has brought together in one volume [10] comparable and consistent national accounts for its member countries 1953-1969 based upon its current standardized system. As a farewell, let us use it to see what has happened lately to capital coefficients and propensities to save in eight advanced[1] countries. Let our theoretical framework be the Harrod-Domar model[2], crude enough to fit such crude data.

2. Capital Coefficients

What the capital coefficient b is used for in the Harrod-Domar model is the derivation from its Eqs. (2) and (3) of the investment

function

$$I = b \frac{dX}{dt}$$

It follows from Eq. (2) that Harrod-Domar investment I is net investment and from Eq. (5) that Harrod-Domar output X is net output. Consequently use Part Three, Table 2, lines 3, 8, and 17 of the OECD accounts [10] to define

$I \equiv$ net domestic fixed asset formation $\equiv$ gross domestic fixed asset formation at 1963 prices (line 3) minus depreciation and other operating provisions at 1963 prices (line 17).

$X \equiv$ net national product $\equiv$ gross national product at 1963 market prices (line 8) minus depreciation and other operating provisions at 1963 prices (line 17).

$\Delta X \equiv$ annual increments of X.

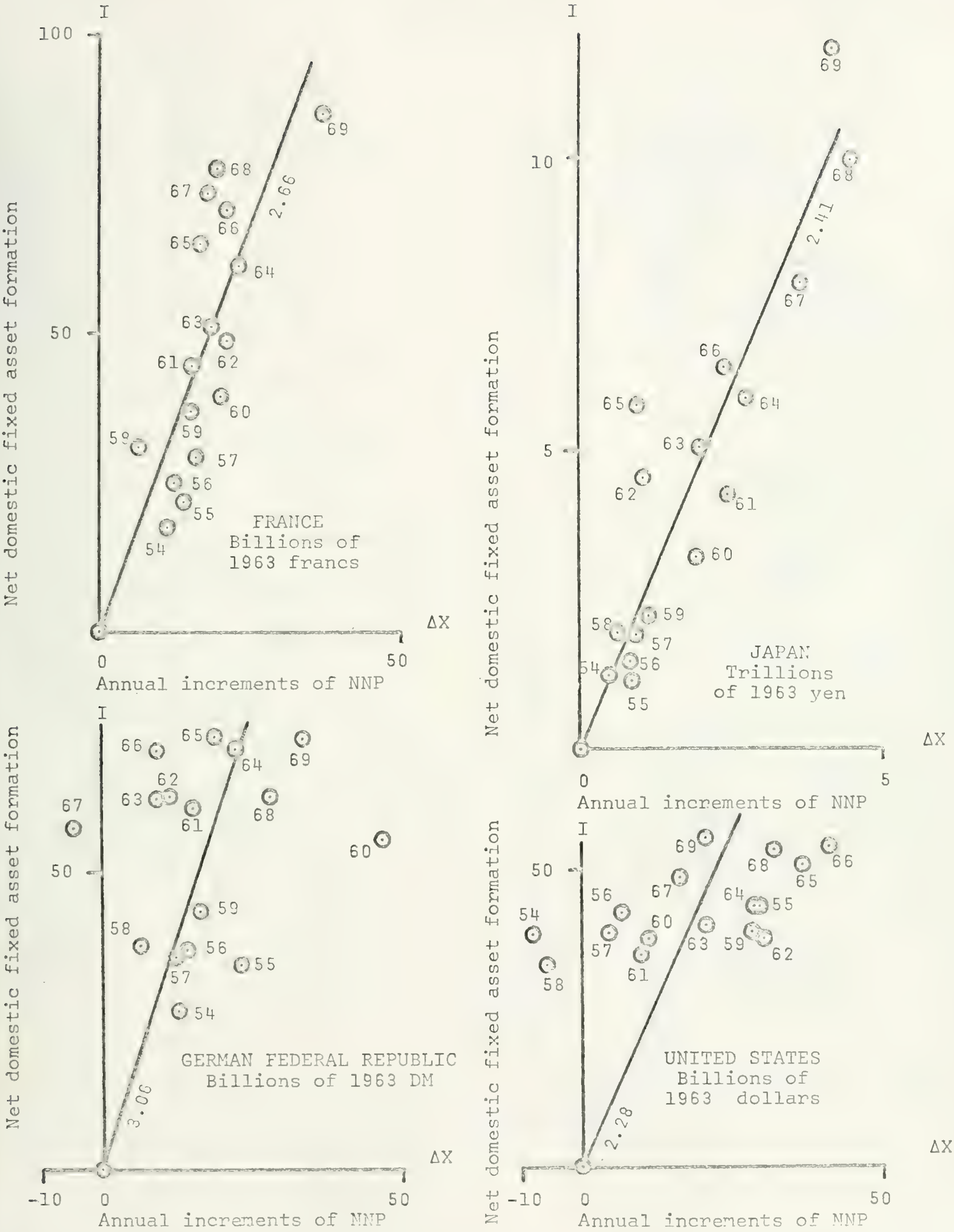

FIGURE 1.—CAPITAL COEFFICIENTS IN FRANCE, JAPAN, GERMANY AND THE UNITED STATES

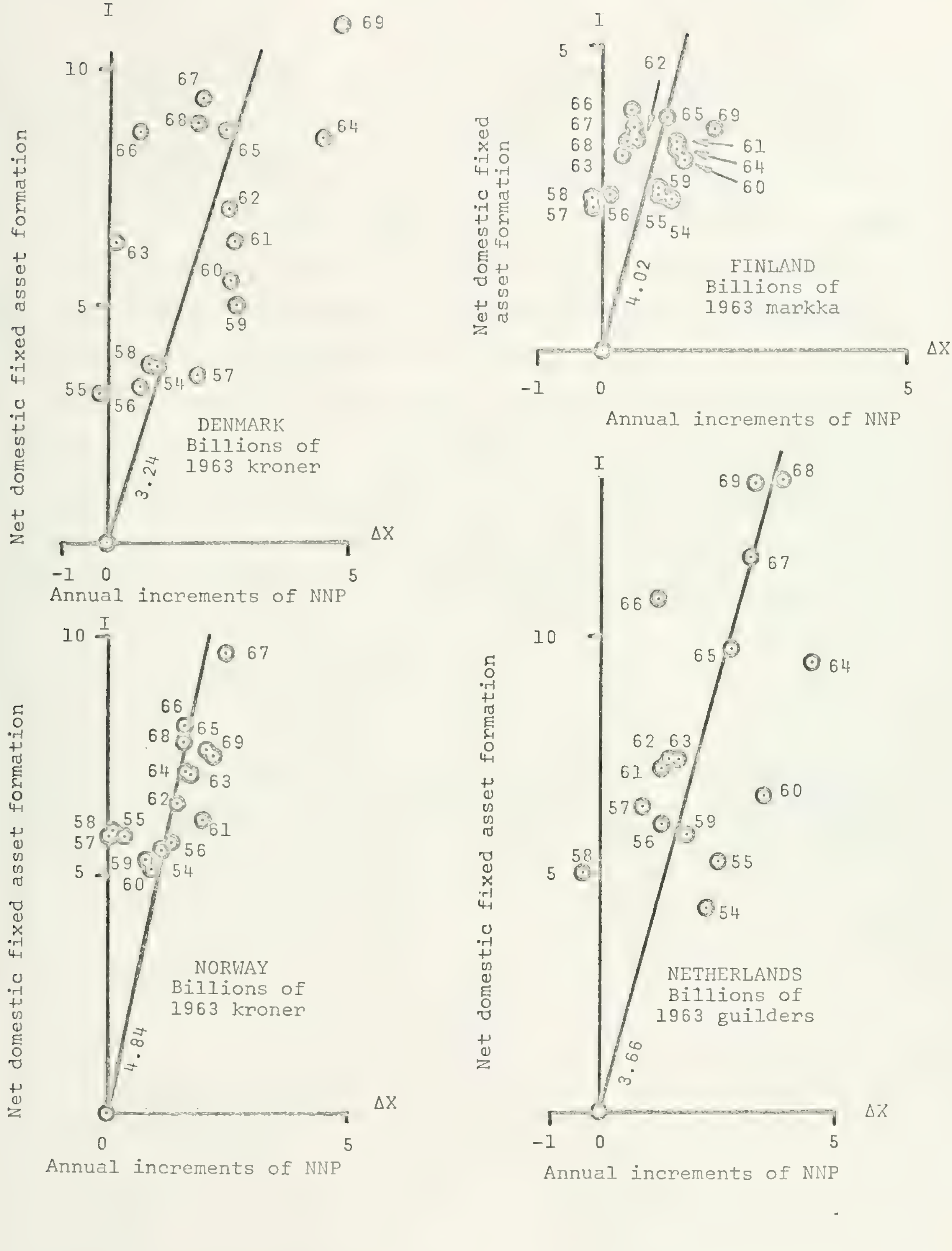

FIGURE 2.—CAPITAL COEFFICIENTS IN DENMARK, FINLAND, NORWAY AND THE NETHERLANDS

In Figures 1 and 2 we have plotted corresponding values of I and ΔX thus defined for each of the sixteen years 1954-1969 for each of the eight countries. If for any country from any of the sixteen points a straight line were drawn to the origin, the slope of that line would represent the value of the capital coefficient for that year in that country. To avoid cluttering the diagrams, such lines have not been drawn explicitly.

For each country one straight line through the origin has been drawn, however. For each country, sum net investment over the sixteen years and call the result ΣI. Sum incremental net national product over the same sixteen years and call the result $\Sigma\Delta X$. The slope of the straight line through the origin shows the ratio

$$\Sigma I/\Sigma\Delta X = b$$

representing the overall capital coefficient for the entire period 1954-1969. The eight values of b appear as labels on the straight

TABLE 1.—CAPITAL COEFFICIENTS, PROPENSITIES TO SAVE, CALCULATED AND ACTUAL GROWTH RATES IN EIGHT COUNTRIES 1953-1969

	b	$1 - c$	Calculated $g_X \equiv (1 - c)/b$	Actual g_X where $e^{16g_X} \equiv X(1969)/X(1953)$
Denmark	3.24	0.131	0.040	0.040
Finland	4.02	0.177	0.044	0.046
France	2.66	0.138	0.052	0.053
Germany*	3.06	0.167	0.055	0.059
Japan	2.41	0.223	0.093	0.091
Netherlands	3.66	0.171	0.047	0.048
Norway	4.84	0.192	0.040	0.039
United States	2.28	0.081	0.035	0.034

*Federal Republic.

lines through the origins in Figures 1 and 2 as well as in the first column of Table 1.

Two questions are raised by Figures 1 and 2. First, in each country could the sixteen implicit, undrawn, lines through the origin be said to cluster around the drawn one? The answer is that even the poor clustering in our Figures 1 and 2 has degrees. Clustering is most pronounced in France and Japan and least pronounced in the United States.[3] How come?

Let investment be motivated by the need for capacity to keep up with demand—as the Harrod-Domar model assumed it to be. Still investment is always to some extent postponeable. But it is less postponeable under rapid growth than under slow growth: Demand is catching up more rapidly, and the issue of expanding capacity is pressing with more urgency. Furthermore, investment is less likely to be postponed under smooth growth than under stop-and-go growth. With demand growing smoothly there is less uncertainty about the exact time at which demand has outgrown capacity for good. With demand growing smoothly, the responsiveness of the capital market to

a new stock issue or the attractiveness of credit terms will both fluctuate less than under stop-and-go growth. Postponement of investment, then, is less likely to bring a more responsive capital market or more attractive credit terms.

All this leads to the conclusion that investment would be more closely geared to incremental net national product in rapidly and smoothly growing economies like France and Japan than it would be in a jerkily and slowly growing economy like the United States. Figures 1 and 2 show that such was actually the case.

The second question raised by Figures 1 and 2 is whether or not the eight countries differ in their capital coefficients. They do: The highest value 4.84 (Norway) is about $2^1/_8$ times the lowest value 2.28 (United States). The national ranking of our capital coefficients is roughly the same as that of Leibenstein's [6] U. N. data for 1949-1959—with the United States as the big exception.

National differences in capital coefficients are not surprising: From Bergström [1], 289, Grosse [4], 220-221, Leibenstein

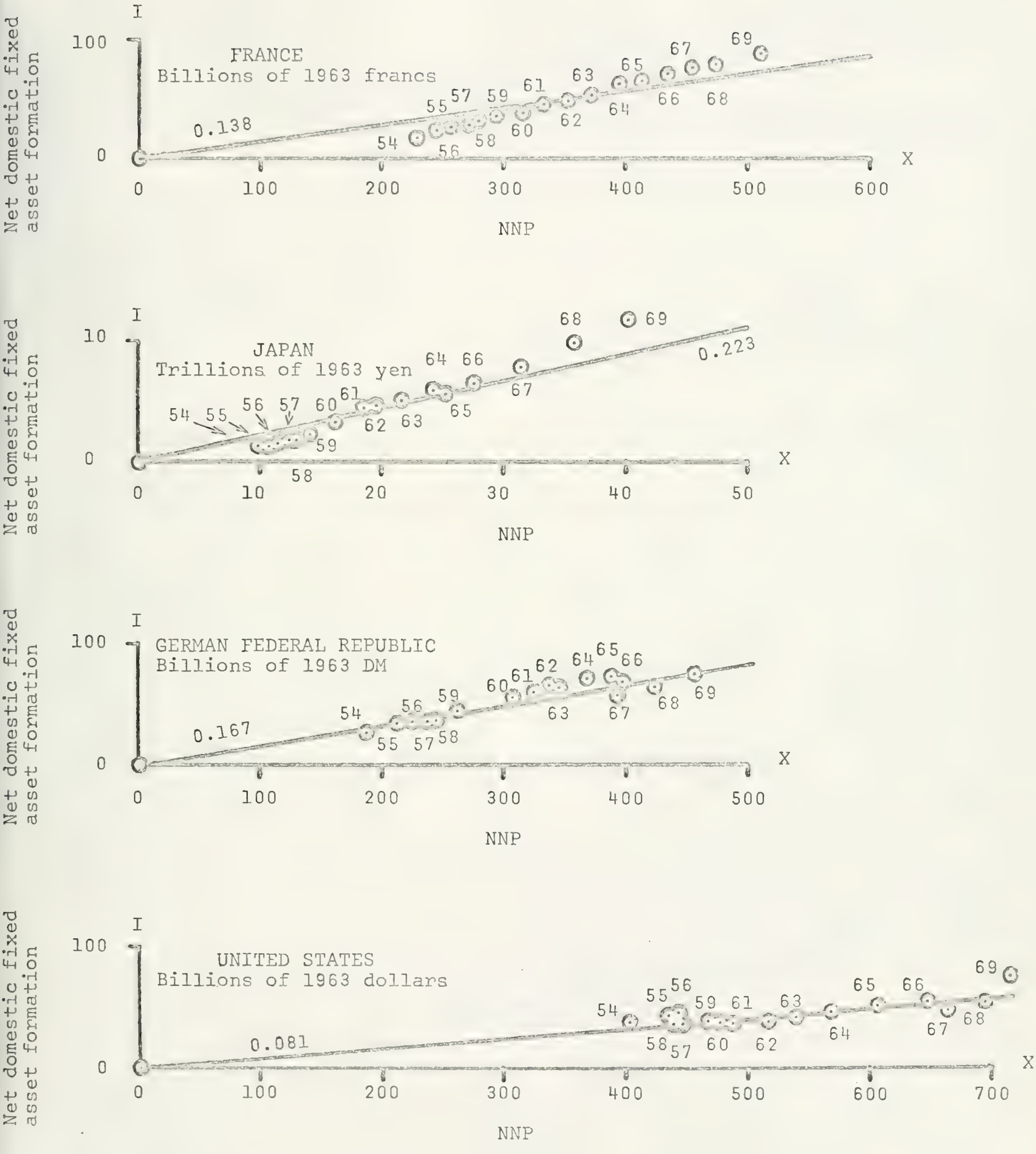

FIGURE 3.—PROPENSITIES TO SAVE IN FRANCE, JAPAN, GERMANY AND THE UNITED STATES

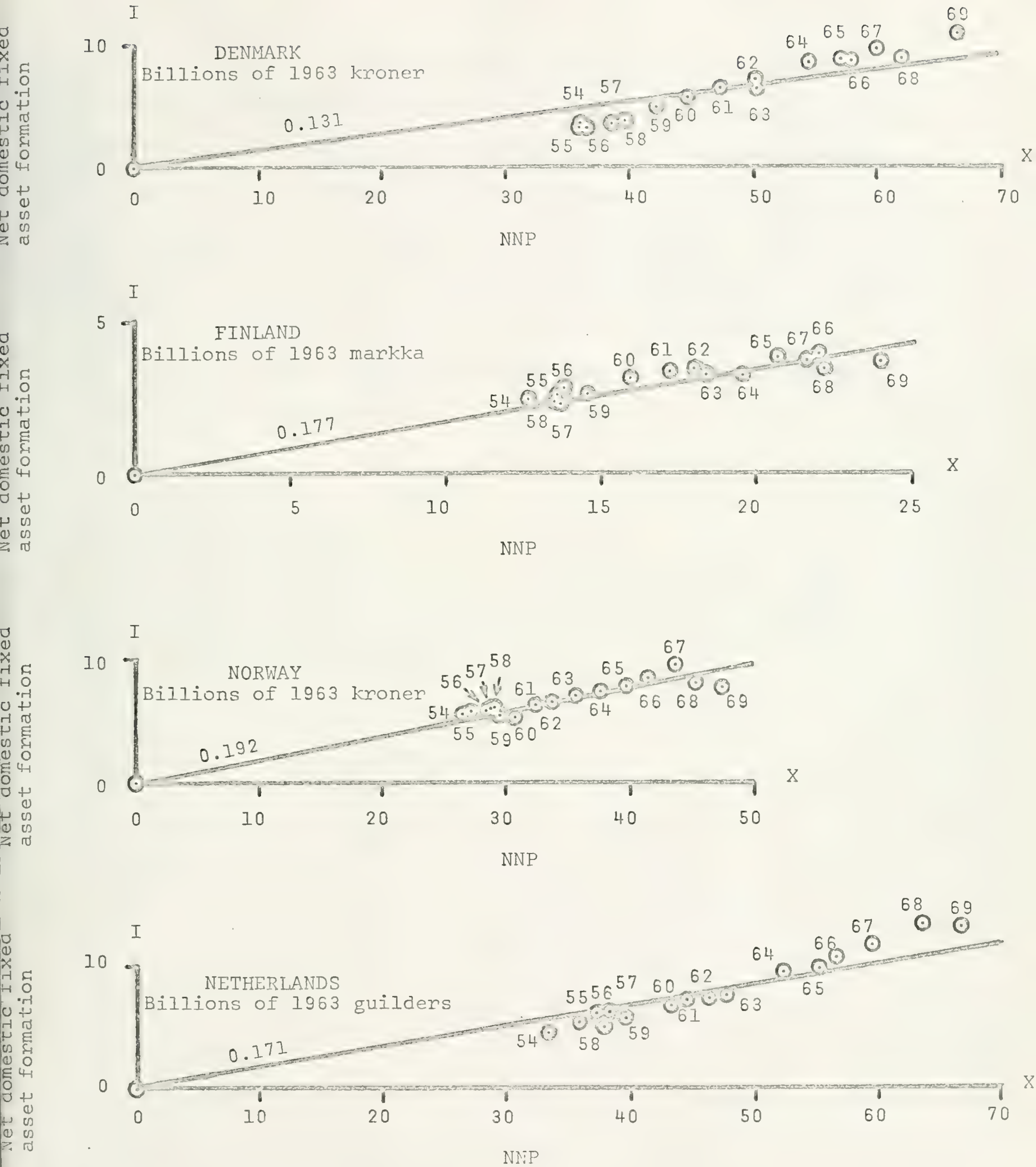

FIGURE 4.—PROPENSITIES TO SAVE IN DENMARK, FINLAND, NORWAY AND THE NETHERLANDS

[6], 27, Lindberger [7], 45-52, and Lundberg [9], 110-111, we know that capital coefficients differ markedly among industries. Hence national capital coefficients must reflect national industry mix. And the smaller a country is, the more one-sided its industry mix is likely to be. Thus the traditionally high Norwegian capital coefficient must reflect the high capital coefficients of electric power generation [4], [7], and transoceanic transportation [4]. The high Finnish capital coefficient must reflect the high capital coefficient of wood pulp [1], [9].

3. Propensities to Save

What the propensity to save $1 - c$ may be used for in the Harrod-Domar model is the derivation from its Eqs. (4) and (5) of the investment-savings equation

$$I = (1 - c)X$$

Part Three, Table 10, lines 6 through 9 of the OECD accounts [10] use the terminology that gross addition to national wealth equals gross fixed asset formation <u>plus</u> change in stocks <u>minus</u> residual error <u>plus</u> net lending to the rest of the world. A Harrod-Domar economy is a closed one, so there is no lending to or borrowing from the rest of the world, and Eq. (5) of the Harrod-Domar model rules out change in stocks. Ignoring the residual error, then, Harrod-Domar gross saving equals gross addition to national wealth equals gross fixed asset formation. Harrod-Domar net saving at 1963 prices equals I as defined in Section 2 above. Harrod-Domar net national product at 1963 prices equals X as defined there.

In Figures 3 and 4 we have plotted corresponding values of I and X thus defined for each of the sixteen years 1954-1969 for each of the eight countries. If for any country for any of the sixteen points a straight line were drawn to the origin, the slope of that line would represent the value of the propensity to save

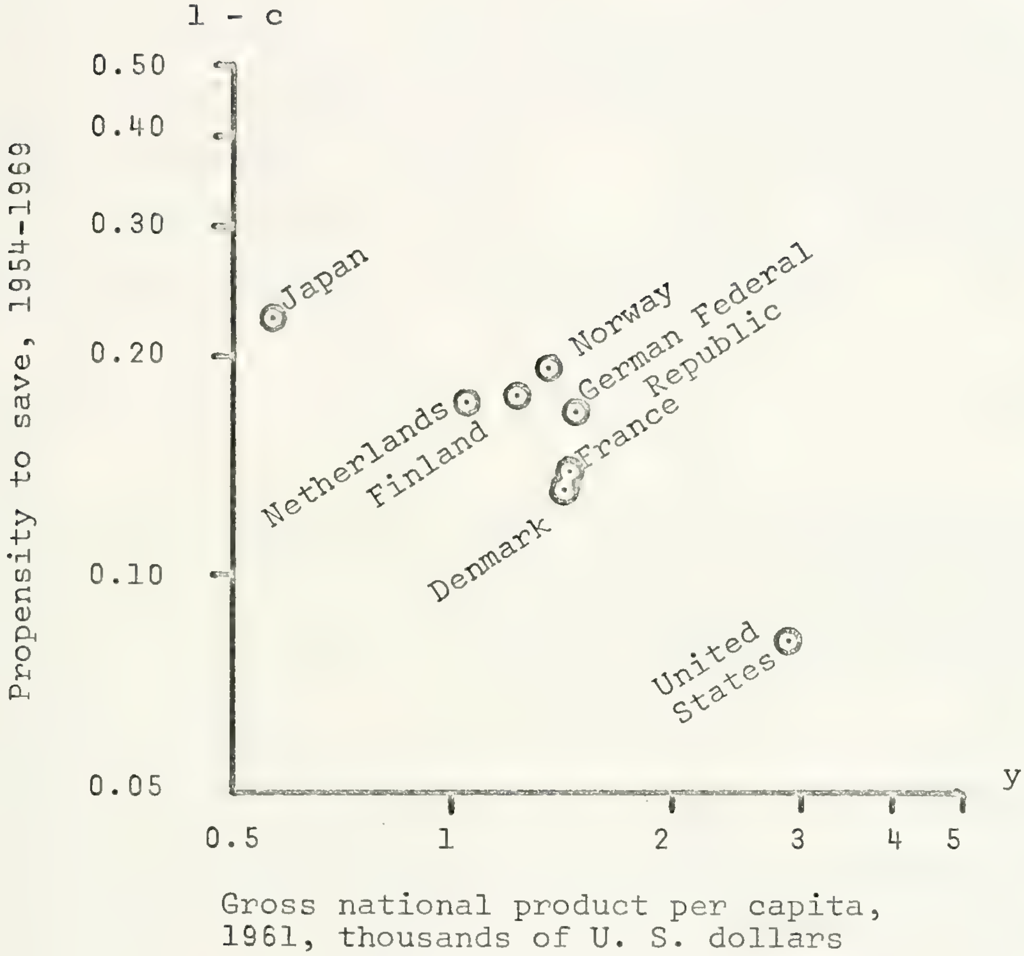

FIGURE 5.—PROPENSITY TO SAVE AS A FUNCTION OF GROSS NATIONAL PRODUCT PER CAPITA, INTERNATIONAL CROSS SECTION

for that year in that country. The sixteen lines would cluster very heavily. To avoid the congestion, they have not been drawn explicitly.

For each country one straight line through the origin has been drawn. For each country, sum net investment over the sixteen years as before and call the result ΣI. Sum net national product over the same sixteen years and call the result ΣX. The slope of the straight line through the origin shows the ratio

$$\Sigma I/\Sigma X = 1 - c$$

representing the overall propensity to save for the entire period 1954-1969. The eight values of $1 - c$ appear as labels on the straight lines through the origins in Figures 3 and 4 as well as in the second column of Table 1.

Figures 3 and 4 raise the same two questions as did Figures 1 and 2. In each country could the sixteen implicit, undrawn, lines through the origin be said to cluster around the drawn one? The answer is that the cluster is far better than it was in Figures 1

and 2. Furthermore, no noticeable difference between the marginal and the average propensity to save exists in Finland, Germany, Norway, or the United States. But in Denmark, France, Japan, and the Netherlands the marginal propensity to save is visibly higher than the average one. This is another way of saying that the Danish, French, Japanese, and Dutch average propensity to save must have been rising from 1954 to 1969.

The second question raised by Figures 3 and 4 is whether or not the eight countries differ in their propensities to save. They do indeed: The highest value 0.223 (Japan) is about $2\,^{3}/_{4}$ times the lowest value 0.081 (United States).[4] How can such differences be explained? Much of them will be explained by per capita gross national product. Use Part One, lower table p. 10 to define

y ≡ gross national product at market prices per capita in U. S. dollars for 1961

In Figure 5 we have plotted corresponding values of 1 - c and y for each of the eight countries. On the double-logarithmic scale

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used, the relationship is well approximated by a negatively sloped straight line.

Why negatively sloped? Remember that we have measured saving by measuring investment. OECD accounts know only investment in physical capital. If, as they advance, economies invest more in human capital (education) and less in physical capital, the propensity to save as measured will drop as observed.

4. Calculated Versus Actual Growth Rates

The solution (6) of the Harrod-Domar model finds the proportionate rate of growth of output to equal the ratio between the propensity to save and the capital coefficient. That ratio is shown in the third column of Table 1 and may be confronted with the actual rate of growth shown in the fourth column. Should we congratulate ourselves on the good correspondence between calculated and actual growth rate?

Much of the correspondence must be inherent: Let growth be steady-state growth and let v and t be any two points of time. That

a variable X is growing at the steady-state rate g_X may then be defined

$$(7) \qquad X(t) \equiv e^{g_X(t - v)} X(v)$$

Now we estimated the overall propensity to save $1 - c$ as $\Sigma I/\Sigma X$ and the overall capital coefficient b as $\Sigma I/\Sigma\Delta X$, hence

$$(1 - c)/b \equiv \Sigma\Delta X/\Sigma X \equiv [X(1969) - X(1953)]/[X(1954 + \ldots + X(1969)]$$

With $v \equiv 1953$ and $t \equiv 1954, \ldots , 1969$ use (7) upon this:

$$(8) \qquad (1 - c)/b \equiv (e^{16g_X} - 1)/(e^{g_X} + \ldots + e^{16g_X})$$

In the denominator, find the sum of the terms of the geometrical progression and write

$$(1 - c)/b \equiv 1 - e^{-g_X}$$

So far in this section, all equalities have been definitional ones. But

$$e^x = 1 + x + x^2/2! + x^3/3! + \dots$$

Replacing x by $-g_X$ we have

$$1 - e^{-g_X} \simeq g_X \tag{9}$$

where the symbol $\simeq$ is used to denote approximate equality. In addition to this approximation, the steady-state growth assumed in (7) was an approximation to actual growth, hence the sum of the terms of the geometrical progression in the denominator of (8) was also an approximation. Approximations (7) as well as (9) being good, we expect the third column of Table 1 to be a good approximation to the fourth column.

*

FOOTNOTES

[1]Capital coefficients require net national product data, and those in turn require depreciation data. Belgium and Switzerland offer depreciation data only from 1956; Sweden offers none at all.

[2]Denoting our variables

$C \equiv$ consumption
$g_X \equiv$ proportionate rate of growth of output
$I \equiv$ investment
$S \equiv$ capital stock
$X \equiv$ output

and using two parameters, i. e., the capital coefficient b and the propensity to consume c, the following six equations constitute the Harrod-Domar model [2], [3], [5], and [8]:

(1) $$g_X \equiv \frac{dX}{dt}\ \frac{1}{X}$$

(2) $$I \equiv \frac{dS}{dt}$$

(3) $$S = bX$$

(4) $$C = cX$$

(5) $$X = C + I$$

Taking (1) through (5) together we solve for g_X:

(6) $$g_X = (1 - c)/b$$

[3]The German cluster is much better than it looks: Adding in 1960 the Saar and West Berlin to the territory covered means, in effect, treating the 1960 Saar and West Berlin product as an increment to the German product <u>without</u> treating existing Saar and West Berlin capital stock as German investment. Since that existing capital stock is not known, we made no attempt to remedy the anomaly. As a result, the slope of a straight line connecting the 1960 point with the origin must be too low.

[4]The United States capital coefficient and propensity to save are both understated, because United States government expenditure on machinery and equipment is treated as government current expenditure rather than as gross domestic fixed asset formation. How much understated?

Government gross fixed asset formation, defined as excluding machinery and equipment, is known, [10], Part Three, Table 7, Line 19. Deduct it from gross domestic fixed asset formation <u>minus</u> machinery and equipment, [10], Part Three, Table 1, Lines 3 <u>minus</u> 3c, and find nongovernment gross fixed asset formation other than machinery and equipment. Domestic is around $^4/_3$ of nongovernment gross fixed asset formation other than machinery and equipment. Suppose the fraction $^4/_3$ applied to machinery and equipment as well. Then gross domestic fixed asset formation <u>with</u> government expenditure on machinery and equipment included would be around $^1/_6$ higher than as recorded without. If the same were true of net domestic fixed asset formation, then our understated capital coefficient and propensity to save should both be raised by $^1/_6$ to 2.66 and 0.095, respectively. Even so, still no other country would have lower values than the United States.

R E F E R E N C E S

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